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3-D Microwave Absorbers With Ultrawide Bandwidths and Simple Structures: From Synthetic Design to Implementation

Tian-Xi Feng, Lei Zhu
University of Macau, Taipa, Macau 999078, China;
e-mail: feng.tianxi@connect.um.edu.mo; leizhu@um.edu.mo

In this paper, we try to propose the synthetic design and implementation of a class of 3-D microwave absorbers with ultrawide bandwidths and simple structures. Firstly, we construct the general equivalent transmission line (TL) model of the proposed 3-D absorber element based on two sets of shunt short-ended stubs and an *i*-section nonuniform connecting line. The equivalent model is then utilized for the theoretical synthetic procedure, which aims to establish an ultra-wide absorption band with the Chebyshev equal-ripple response. Using the above synthesis approach, the relevant parameters of the TL model can be directly calculated according to the specifications of absorptive performance, such as maximum reflection coefficient (Γ) and fractional bandwidth (FBW). To prove our presented concept, two prototypes, namely, absorber-I (i=1) and absorber-II (i=2), are designed, fabricated, and measured. For each prototype element, a single-layered substrate is employed to obtain the very simple 3-D structure, which consists of slotlines, microstrip lines, and only one absorptive load. Measured results agree well with synthetizations and simulations. As for absorber-I, the measured (simulated) bandwidth of 95.5% in a frequency range from 5.08 to 14.44GHz (94.9% from 5.18 to 14.54GHz) is successfully realized. Absorber-II realizes a measured (simulated) bandwidth of 111.1% in a range from 4.48 to 15.68GHz (112.2% from 4.37 to 15.54GHz). Within the operating band, measured average absorption ratios (ARs) for absorber-I and absorber-II are higher than 95.5% and 93.8%, respectively. In addition, the proposed 3-D absorbers possess angular stability in 60° oblique incidence with absorption ratios higher than 80%. Therefore, such ultra-wideband 3-D microwave absorbers with simple structures own their potential for electromagnetic compatibility.